
Stormwater Management Report

2798.820 kW Solar Energy Generating Facility

127 Stow Street Acton, MA &
0 Rear South Acton Road Stow, MA

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Submitted to:

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Planning Board/Conservation Commission
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&

Town of Acton
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February 29, 2016

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1.0 Executive Summary

Borrego Solar Systems, Inc. has prepared this Stormwater Management Report (Report) for a 2798.820 kW (DC) renewable energy generating facility. This is a joint report since the project consists of the installation of one (1) individual ground-mounted solar photovoltaic system that is situated on land in both Stow and Acton, Massachusetts at (APN Map R31 Lot 6) and (APN Map H1 Lot 6), respectively. Although this is a joint application the majority of the work associated with the solar project is in Stow, Massachusetts. The interconnection route is located entirely in Acton, Massachusetts. This report is intended to support the following town permitting processes:

- Town of Acton Planning Board and Site Plan Review
- Town of Acton Conservation Commission for Notice of Intent
- Town of Stow Planning Board and Site Plan Review
- Town of Stow Conservation Commission for Notice of Intent

2.0 Project Description

The proposed project consists of a photovoltaic solar array installation that will produce up to 2798.820 kilowatt (kW) of Direct Current (DC) electricity. The system will occupy approximately 10.3 acres (inside the fence) of the site and the systems will be placed entirely in the upland areas of the site. The solar panels will be installed on a driven pile foundation support racking system and the only impervious surfaces to be constructed will be the electrical equipment pads.

The proposed project will consist of the following key components:

- Solar modules
- Power inverters
- Power transformer
- Underground electrical conduits
- Operations and maintenance (O&M) building supervisory control and data acquisition (SCADA) system
- Overhead interconnection transmission line
- Access and maintenance roads

This type of system minimizes the need for grading (earth disturbance) of the site. Earthwork associated with grading the project area in order to accommodate the solar racking is included.

3.0 Introduction

The site is located in Stow and Acton, Middlesex County, Massachusetts on the west side of Stow Street (Acton)/South Main Street (Stow) on the Fletcher Realty Trust land. The parcels (Stow and Acton) consist of approximately 24.5 acres of private land and that the portion planned for the project site (the Site) will consist of approximately 10.3 acres. Access to the site is via an existing gravel access road on South Acton Road in Stow. This road will be maintained in its existing location. The interconnection route (overhead poles/wires) is primarily in Acton. Refer to Figure 1 – *Site Locus Map* and Figure 2 – *Site Aerial Map*. The property (project location) consists of active commercial landscaping business, gravel/sand/loam stockpiles and vacant land.

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The portion of the site to be developed as a solar photo voltaic system is planned to slope to the north and east from a highpoint in the central portion of the site. Elevations within the fenced area range from 300 down to 200 to the wetlands to the north and east. These slopes are appropriate for the installation of the solar racking as well as for generating electricity.

Table 1 summarizes the ground cover distribution for the hydrologic area (not the parcel area) for existing and proposed conditions. In total, there is only a 200 square foot increase in the quantity of impervious area (none exists today) associated with the proposed development. This is directly due to the concrete electrical equipment pads. These areas are shown on Figure 3 – *Existing Watershed Map* and Figure 4 – *Proposed Watershed Map*.

Table 1 Ground Cover Hydrologic Area

Cover Type	Condition	Existing Area (acres)	Proposed Area (acres)
Meadow		-	
Gravel Driveway		-	
Woods	Good	10.02	
Woods	Poor	4.05	
Dirt Roads		8.08	
Concrete Pads		-	0.0002
	Totals	22.15	22.15
	Curve Number	69	

*Concrete pads value does not show in Hydrocad analysis due to small area

3.1 Hydrologic Soil Types

Hydrologic soil groups are used in equations that estimate runoff from rainfall. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. The soils of the U.S. are placed into four groups A, B, C, D. Definitions of the classes are as follows:

- Hydrologic Group A: Soils with low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well drained to excessively well-drained sands or gravels.
- Hydrologic Group B: Soils having moderate infiltration rates even when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well drained to well drained soils with moderately fine to moderately coarse textures.
- Hydrologic Group C: Soils having slow infiltration rates even when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures.
- Hydrologic Group D: Soils with high runoff potential. Soils having very slow infiltration rates even when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.

Each of the soils associated with the project site (not the 26 acre parcel) are noted below along with their hydrologic soil group. Refer to Figure 5 – *Soils Survey* for the entire parcel soil type breakdown.

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3.2 Soil Types

Soil data was collected from the United States Department of Agriculture (USDA) Natural Resources Conservation Service web-based soil survey. Refer to Figure 5 – *Soils Survey*. Based on the soils survey, the hydrological study area consists of four soil types:

- 52A, Freetown Muck, 0 to 1% slope, very poorly drained, Hydrologic soil group (HSG) A/D;
- 245B, Merrimac Fine Sandy Loam, 3 to 8 percent slopes, Hydrologic soil group A;
- 260B, Sudbury Fine sandy loam, 3 to 8 percent slopes, Hydrologic soil group B;
- 307B, Paxton Fine sandy loam, 0 to 8 percent slopes, extremely stony, HSG C;
- 307C, Paxton Fine sandy loam, 8 to 15 percent slopes, extremely stony, HSG C;
- 307D, Paxton Fine sandy loam, 15 to 25 percent slopes, extremely stony, HSG C; and
- 652, Udorthents, refuse substratum.

3.3 Proposed Conditions

The proposed project will include the installation of solar panels using driven pile support posts. No impervious coverage of the ground results from the solar panel installation as rainfall is able to freely pass between, under and around the solar panels. Using these types of support systems minimizes impact on the existing ground surface. A 6-foot high chain link will be constructed around the perimeter of the site with an access gate located at the existing gravel access way leading out to South Main Street. This same gravel access drive will be utilized for construction access. Approximately 10.3 acres will be within the fenced area.

Proposed watersheds and flow paths are similar in both the pre- and post-construction condition as they both ultimately discharge into the wetland system to the west.

Ground Cover: There is a significant change in the final use (cover type) of the project area; the fenced in project area will now be mowed once or twice a year and will fall under the cover type *“Meadow-continuous grass, protected from grazing and generally mowed for hay”* as defined in Table 2-2c of Technical Release 55. The respective curve number is __. There are small areas (concrete pads, gravel access ways along with much of the existing conditions not modified) which require different cover types (“Paved parking lots, roofs, driveways...” and “Gravel”) and different runoff curve numbers, 98 and 85, respectively. The project area will be mowed in order to properly maintain the solar facility.

3.4 Rainfall Amounts

Table 2 summarizes the total rainfall amounts input into the HydroCAD analysis for the above mentioned storm events. Refer to Appendix A – Hydrological Analysis for the HydroCAD input/output calculations.

Table 2 Total Rainfall vs. Storm Frequency

Storm Event (24-hour)	Total Rainfall Amounts (inches)
2-Year	3.1
10-Year	4.5
100-Year	6.5

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The rainfall amounts summarized in Table 2 are based on review of the precipitation values for Massachusetts (and the specific county [Middlesex] the site is located in) described in Technical Release 55, *Urban Hydrology for Small Watersheds* published by the United States Department of Agriculture, Natural Resources Conservation Service Conservation Engineering Division dated June 1986 and confirmed based on review of the *Handbook for Conservation Commissioners* by the Massachusetts Department of Environmental Protection dated March 2002.

4.0 Stormwater Analysis

4.1 Existing Stormwater Management

4.1.1 Existing Drainage System

The project area existing stormwater runoff discharges overland to the west, north and east to the bordering vegetated wetlands. For analysis of the existing condition there are two (2) points of analysis for this project area (POA-1 and POA-2). Refer to Figure 3 – *Existing Watershed Map* for analysis locations and watershed boundaries.

4.1.2 Existing Watershed

Under existing conditions, two (2) sub-catchment areas were developed in order to model and evaluate the projects runoff discharges. Refer to Figure 3, *Existing Watershed Map*.

- Sub-catchment Area **1E** consists of wooded areas and areas actively utilized for dirt/gravel roads, storage lots and working grading areas. This area discharges overland towards the west to north to north east and the wetlands. This point of analysis is **POA-1** and includes a tributary area of 13.9 acres.
- Sub-catchment Area **2E** consists of wooded areas to the central and easterly portions of the site. This area discharges overland and easterly towards the wetlands associated with a small intermittent stream that runs southerly. This point of analysis is **POA-2** and includes a tributary area of 8.25 acres.

The total hydrologic area is 22.15 acres.

4.1.3 Existing Runoff Calculations

In order to determine the peak rate of discharge for existing conditions, runoff hydrographs (1S and 2S) were generated for the storm events using the Soils Conservation Service (SCS) Technical Release 20 Method. Refer to Appendix A for HydroCAD Calculations. Under the existing conditions, runoff hydrographs were routed over the current land uses. As part of this Stormwater Report we modeled the peak stormwater runoff rates within the property boundary and did not analyze any offsite drainage system runoff from the project does not discharge onto the site. The existing stormwater discharge rates are shown in Table 3.

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Table 3 Existing Conditions Peak Stormwater Runoff Rates

Points of Analysis (POA)	Tributary Area (acres)	Peak Runoff Rates (cfs)		
		2-Year Storm	10-Year Storm	100- Year Storm
POA-1	13.9	5.7	16.9	36.9
POA-2	8.25	6.8	13.8	24.9
	22.15			

cfs = cubic feet per second

4.2 Proposed Stormwater Management

4.1.1 Proposed Drainage System

There are no drainage improvements to municipal systems (i.e. catch basins, manholes, pipes) proposed as part of this project. The only changes to cover type include the 200 square feet of concrete equipment (electrical) pads located in the central portion of the project site along with approximately 14,910 square feet of new gravel driveway. Within the perimeter fence the disturbed areas will be hydroseeded with the seed mix described on the Site Plans.

4.1.2 Proposed Watersheds

Under proposed conditions, two (2) sub-catchment areas were developed in order to model and evaluate the projects runoff discharges. Refer to Figure 3 - *Proposed Watershed Map*.

- Sub-catchment Area **1P** consists of mostly wooded areas to the southwest of the solar system along with newly graded and seeded areas inside the solar system fence.. Some of the proposed gravel driveway and the electrical equipment area (with the concrete pads) are also located in **1P**. This area continues to discharge overland towards the north and the bordering vegetated wetlands. This point of analysis is **POA-1** and includes a tributary area of 13.9 acres.
- Sub-catchment Area **2P** consists of wooded areas to the south of the solar system and newly graded and seeded areas inside the solar system fence. This area continues to discharge overland and easterly towards the wetlands. This point of analysis is **POA-2** and includes a tributary area of 8.25 acres.

The total hydrologic area is 22.15 acres.

4.1.3 Proposed Runoff Calculations

In order to determine the peak rate of discharge for proposed conditions, runoff hydrographs (PR-1 and PR-2) were generated for the storm events using the Soils Conservation Service (SCS) Technical Release 20 Method. Refer to Appendix A for HydroCAD Calculations. Under the proposed conditions, runoff hydrographs were routed over the re-graded and re-vegetated conditions proposed for this site. The proposed stormwater discharge rates are shown in Table 4.

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Table 4 Proposed Conditions – Peak Stormwater Runoff Rates

Points of Analysis (POA)	Tributary Area (acres)	Peak Runoff Rates (cfs)		
		2-Year Storm	10-Year Storm	100- Year Storm
POA-1	13.9	0.14	2.5	12.8
POA-2	8.25	4.2	10.0	19.7
	22.15			

cfs = cubic feet per second

The following table 5 summarizes the pre- and post-development peak runoff discharge rates as shown in tables 3 and 4 above.

Table 5 Comparison of Peak Stormwater Runoff Rates

Points of Analysis (POA)	Peak Runoff Rates (cfs)								
	2-Year Storm			10-Year Storm			100-Year Storm		
	Pre	Post	△	Pre	Post	△	Pre	Post	△
POA-1	5.7	0.14	(5.56)	16.9	2.5	(14.4)	36.9	12.8	(24.1)
POA-2	6.8	4.2	(2.6)	13.8	10.0	(3.8)	24.9	19.7	(5.2)

cfs = cubic feet per second

nc = no change

As shown in Table 5, post-development peak stormwater runoff rates for the project are less than pre-development peak stormwater runoff rates for both points of analysis. The 2 points of analysis are part of one larger wetland system that surrounds the Fletcher parcel on the west, north and east and are hydrologically connected.

Although the individual solar panels are an impervious surface, they do not rest on the ground are considered disconnected surfaces by MA DEP. Furthermore, there are gaps between each solar panel in any given array and the solar panels sit at an angle to, and several feet above the ground. Thus, rainwater can pass in between each individual panel and in between the rows of panel arrays to the underlying fully vegetated ground and unencumbered soils. As such, the solar panels and arrays do not add any impervious coverage from a stormwater management standpoint as water is free to fall into, pass under, and soak into all of the vegetated land under the panels. This design philosophy is consistent with DEP practice with respect to solar facilities such as this. In actuality, for this particular site, the proposed re-vegetation will improve it's (the grounds) ability to absorb rainfall.

5.0 Stormwater Management Standards Compliance

As outlined in the Massachusetts Stormwater Handbook, the ten Stormwater Management Standards are applied to this project in accordance with the Wetlands Protection Bylaw, the Department of Environmental Protection (DEP) Stormwater Management Policy.

This project will comply will all of the standards set forth in the Massachusetts Stormwater Standards and Handbook. How each standard is complied with is shown below.

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Standard No. 1: No new stormwater conveyances may discharge untreated directly to or cause erosion in wetlands or waters of the Commonwealth.

There are only negligible (200 square feet) new impervious surfaces associated with this project. The stormwater runoff quality discharged from this site will be very similar due to the pre-development condition since no change to surface type is proposed. Any erosion of the soils will be significantly minimized through the vegetative coverage of soils and the erosion and sedimentation control measures proposed during construction.

Standard No. 2: Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.

The solar panels are installed on screw foundations and are elevated above the existing ground. The leading (lower) edge is planned to be approximately 36 inches above existing grade and the back edge will be approximately 9 feet above grade. Any precipitation that falls on the solar panels will shed between the individual solar panels in any given array and directly onto the underlying ground, thereby not adversely affecting annual groundwater recharge. The improved vegetation proposed for the site will improve stormwater infiltration throughout the site.

The impervious area created by a solar panel is considered to be the area of the foundation (cross-sectional area of the support) of the panels, not the panels themselves (see discussion above). The supports for the panel arrays are quite small in cross-sectional area such that over the entire project site, the foundation supports equate to approximately 22 square feet for the H-pile supports.

Each rack (array) holds 12 solar panels (2 high by 6 wide in a portrait pattern) for this racking system. There are also spaces between each of the solar panels that allow precipitation to drip through.

Aside from the equipment pads (200 square feet), the only change to cover type is the proposed vegetative surface cover (meadow grasses) and the gravel access aisles.

In order to determine the peak rate of discharge for existing and proposed conditions, runoff hydrographs were generated for the 2-, 10- and 100-year, 24-hour storm events using the Soil Conservation Service (SCS) Technical Release 20 Method and Type III rainfall distribution. As shown in Table 5 above, overall post-development peak stormwater runoff rates for the project are less than or equal to the pre-development peak stormwater runoff rates in all design storms. The proposed project will not increase the rate of runoff.

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Standard No. 3: Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operations and maintenance. At a minimum, the annual recharge from pre-development site shall approximate the annual recharge from pre-development conditions based on soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

There is only a minor increase (220 square feet) of impervious cover proposed as part of this project. Annual recharge to groundwater will continue to occur due to the fact that the solar panels are installed on supports and are elevated above the existing ground. Any precipitation that falls on the solar panels will shed directly onto the ground not affecting annual groundwater recharge. Each solar panel rack is installed with space between each of the solar panels that allow precipitation to drip through. The areas around the equipment are installed with gravel base-cleaned washed stone and provides recharge capacity.

Standard No. 4: Stormwater Management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

The minimal amount of impervious cover proposed as part of this project are not for vehicular access. Therefore there are no generators (impervious surfaces) of TSS as part of the proposed project. Furthermore, all such areas are surrounded by gravel surfaces which will capture and infiltration runoff from these small areas of impervious coverage. Any access to the project will be via 12 to 16 feet wide existing and new gravel drives and stormwater runoff will be allowed to directly recharge into the ground. Such areas will also be surrounded by grassed pervious surfaces, which will encourage further infiltration.

Standard No. 5: For land uses with higher pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

The proposed project is not classified as a "Land Use with Higher Pollutant Loads". This standard does not apply to the project.

Standard No. 6: Stormwater discharges with the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

We have reviewed the Massachusetts Geographical Information System (GIS) and the site is not located within Zone II, Interim Wellhead Protection Areas, or Outstanding Resource Watersheds.

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Standard No. 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5 and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

The project is not a redevelopment project.

Standard No. 8: A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period pollution prevention plan) shall be developed and implemented.

A Stormwater Pollution Prevention Plan (SWPPP) will be implemented to control erosion and sedimentation associated with the construction/installation of the project. Erosion and sedimentation controls will be in place prior to construction-related land disturbance on the site. A NPDES (National Pollutant Discharge Elimination System) Notice of Intent (NOI) will be filed with the US EPA a minimum of 14 days prior to the commencement of construction. The Construction Period Pollution Prevention Plans are described in Section 6 of this report.

Standard No. 9: A long-term Operation and Maintenance Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

An Operations and Maintenance Plan (O & M) has been developed and is included in Appendix B of this report. The O & M Plan will be implemented to ensure that the site stormwater management systems function as designed. The owner of the system has not been determined and they will be responsible for contracting with a solar system operations and maintenance company to implement the attached O & M Plan.

Standard No. 10: All illicit discharges to the stormwater management system are prohibited.

An Illicit Discharge Compliance Statement confirming that no illicit discharges exist on site is included in Appendix C of this report.

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6.0 Construction Period Pollution Prevention Plans

The following information is based on the requirements of the MA DEP Stormwater Management requirements for Standard No. 8.

6.1 Construction Period Operation and Maintenance Plan

During construction a Project a Project Manager and Site Superintendent will be in charge of the requirements included in Standard No. 8. They will both be responsible for implementation of the attached erosion and sedimentation controls, contracting with and coordinating with the subcontractors, notifying the Civil Engineer of record and also noting and areas in need of repair/replacement and modifications to the Construction Period Operation and Maintenance plan. At this point the Project Manager and Site Superintendent have not been determined. The two (2) contacts at this time are:

Joe Busch	Vice President of Operations	jbusch@borregosolar.com	978-513-2637
David Albrecht, PE	Civil Engineer of Record	dalbrecht@borregosolar.com	978-513-2621

The Conservation Commission will be notified at such time when both the Project Manager and Site Superintendent have been determined.

6.2 Pollution Prevention Measures

The following are some of the measures to be utilized to prevent erosion and to control sediment.

Stabilized Construction Entrance: At the beginning of Phase I a stabilized construction entrance must be installed at the location where vehicles are expected to enter and/or exit the site onto South Acton Street in order to prevent the off-site tracking of sediment onto adjacent public roadways. The stabilized construction entrances will consist of compacted three to five inch (3"-5") stone, placed over a layer of geotextile fabric (so as to provide separation from the underlying soil and prevent the stone from being ground down into the soil). The stabilized construction entrance must be wide enough to cover the entire width of the entrance/exit and allow two vehicles to pass comfortably, and it should be flared where it meets the public roadway to accommodate longer construction vehicles. The stabilized construction entrance must be long enough to allow mud and sediment to become dislodged from vehicle tires, and/or a minimum of fifty feet (50') in length.

Over the course of construction, the stabilized construction entrance will become filled with accumulated sediment. The Contractor must inspect the stabilized construction entrance and adjacent public roadways for off-site sediment tracking and repair the entrance as necessary (remove accumulated sediment and add new stone as necessary). If tracking onto public roadways does occur, the streets in the vicinity of the stabilized construction entrance shall be swept immediately. The stabilized construction entrance shall not be removed until just prior to project completion.

Silt Fence: At the beginning of Phase I a silt fence or just silt fence shall be installed to prevent sediment -laden runoff from leaving the site. In addition, silt fence will be used on the down gradient sides of material stockpile areas.

Silt fence is a sediment control BMP consisting of a length of geotextile fabric stretched between anchoring posts spaced at regular intervals along the site at low/down-slope areas. The geotextile

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fabric must be entrenched in the ground between the support posts. Silt fence is effective in treating low velocity sheet flow and is not intended for use in areas of concentrated or channelized flow. Silt fence shall be inspected for rips, tears, and gaps between the fence and the ground. An adequate reserve of silt fence must be kept on site at all times for emergency and/or routine replacement. Silt fence shall be removed only after exposed soils in the contributing drainage area are stabilized. Silt fence can also be used as an effective perimeter control to contain stockpiles of topsoil.

Temporary Stabilization: Per Subpart 2.1.2.4.c of the EPA Construction General Permit, stabilization measures must be initiated as soon as practicable on portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased. Temporary stabilization refers to a variety of erosion control BMPs that protect exposed soils from the erosive forces of precipitation (raindrop and sheet erosion) and/or prevent the formation of channelized flow (rill, gully and channel erosion). The Contractor must inspect temporarily stabilized areas to assess the effectiveness of temporary stabilization BMPs and replace/repair them as necessary.

6.3 Erosion and Sedimentation Control Plans

Please refer to sheet C-4.0 of the attached set of plans. Also find details and specifications on sheet C-5.0.

6.4 Vegetation Planning

Please refer to sheet C-2.0 of the attached set of plans for the re-vegetation of the site.

6.5 Inspection and Maintenance Schedule

The site erosion and sedimentation controls will be inspected each day by the on site superintendent. It will be up to the Site Superintendent as to whether he/she will complete the inspection form every seven (7) days or every fourteen (14) days and when a rain event exceeds 1/4 ". A copy of the inspection form and maintenance (Corrective Action Form) are attached in Appendix D.

7.0 References

Federal Emergency Management Agency (FEMA). *Flood Insurance Rate Map*. Community Panel Number 25017C0353F. Effective July 7, 2014. Accessed February 2016.

United States Department of Agriculture. Natural Resources Conservation Service (NRCS). *Technical Release-55: Urban Hydrology for Small Watersheds*. June 1986.

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Massachusetts Department of Environmental Protection. 2008. *Massachusetts Stormwater Handbook, Volumes 1 – 3*.

Massachusetts Department of Environmental Protection. March 2002. *Handbook for Conservation Commissioners*.

Figures

Figure 1 – Site Locus Map

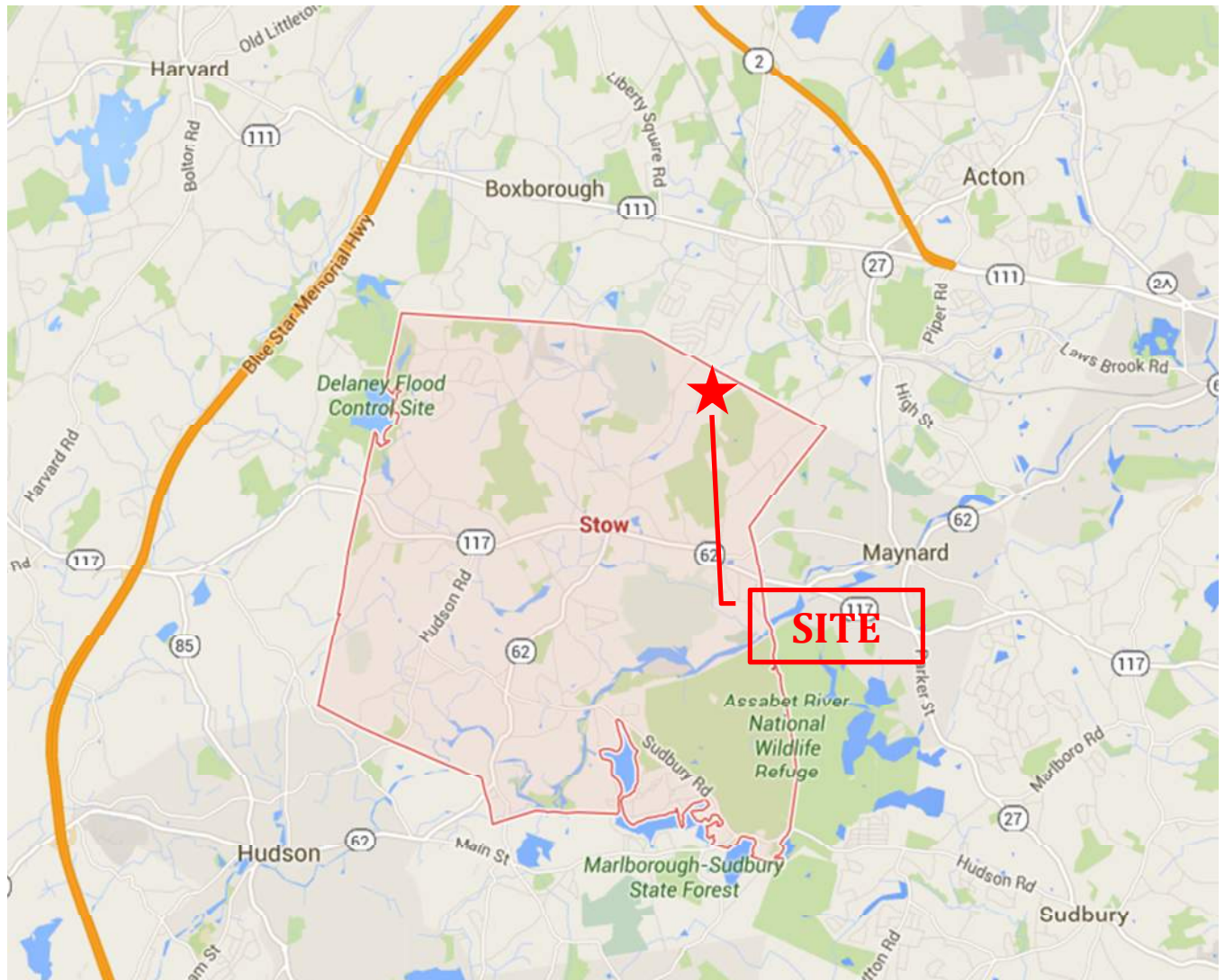


Figure 2 – Site Aerial Map

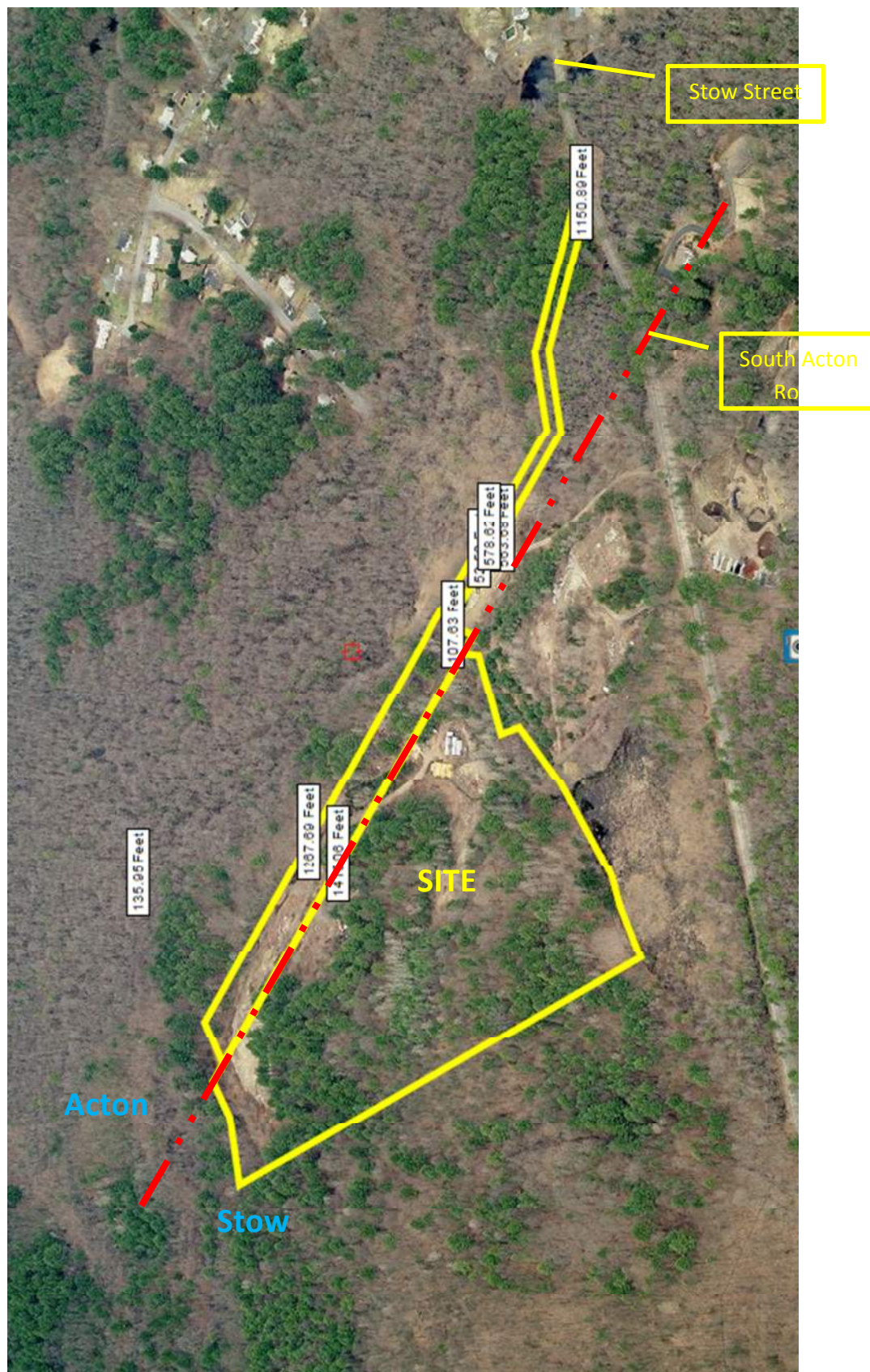
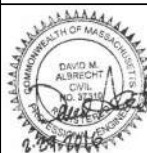


Figure 3 – Pre-Development Watershed Map

1

BORREGO SOLAR
55 TECHNOLOGY DRIVE, SUITE 102
LOWELL, MA 01851
PHONE: (888) 898-6273
FAX: (888) 843-6778
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NOT FOR
CONSTRUCTION



SITE USE PLANS
2798.82 kW SOLAR ENERGY SYSTEM
0 SOUTH ACTON ROAD REAR STOW, MA 01775
127 STOW STREET ACTON, MA 01720

PROJECT NUMBER:
905-0693

[illegible]

SCALES STATED ON DRAWINGS
ARE VALID ONLY WHEN PLOTTER
ARCH D 24" X 36"

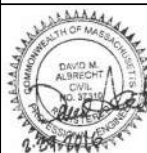


Figure 4 – Post-Development Watershed Map

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PHONE: (888) 898-6273
FAX: (888) 843-6778
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SITE USE PLANS
2798.82 kW SOLAR ENERGY SYSTEM
0 SOUTH ACTON ROAD REAR STOW, MA 01775
127 STOW STREET ACTON, MA 01720

PROJECT NUMBER:
905-0693

[illegible]

SCALES STATED ON DRAWINGS
ARE VALID ONLY WHEN PLOTTE
ARCH D 24" X 36"



Figure 5 – Soils Map



Hydrologic Soil Group

Soil Series	Soil Description	Area (Acres)	Area (%)
82A	Freeflow muck, 0 to 1 percent slopes	2.8	7.6%
85AB	Moraine fine sandy loam, 3 to 6 percent slopes	6.3	17.4%
86AB	Silty fine sandy loam, 3 to 6 percent slopes	0.0	0.0%
87AB	Heavy fine sandy loam, 6 to 12 percent slopes; extremely stony	0.6	1.4%
88AB	Heavy fine sandy loam, 6 to 12 percent slopes; extremely stony	0.7	1.6%
89AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
90AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
91AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
92AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
93AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
94AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
95AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
96AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
97AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
98AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
99AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
100AB	Heavy fine sandy loam, 10 to 25 percent slopes; extremely stony	7.3	20.0%
Totals for Area of Interest		35.5	100.0%

Figure 6 – FEMA Map

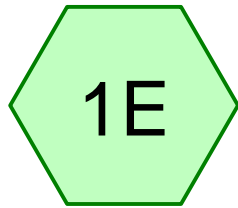


Figure 7 – Groundcover Map

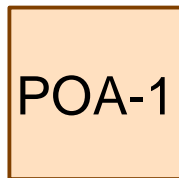


Appendix A

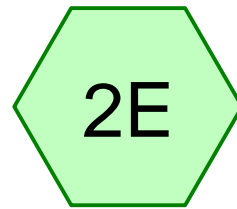
Hydrologic Calculations



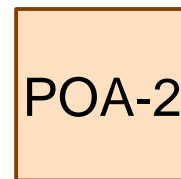
Westerly Portion of Site



Wetlands

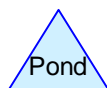
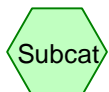


Easterly Portion of Site



Wetlands

Pre-Development



Routing Diagram for Pre-Dev

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.450	72	Dirt roads, HSG A (1E)
0.760	87	Dirt roads, HSG C (2E)
0.862	87	Dirt roads, HSG C, Udorthents (1E, 2E)
1.840	30	Woods, Good, HSG A (1E)
0.180	55	Woods, Good, HSG B/D [Choose B] (1E)
7.280	70	Woods, Good, HSG C (1E, 2E)
0.724	70	Woods, Good, HSG C, Udorthents (1E, 2E)
0.460	45	Woods, Poor, HSG A (1E)
0.400	66	Woods, Poor, HSG B/D [Choose B] (2E)
2.623	77	Woods, Poor, HSG C (1E, 2E)
0.570	77	Woods, Poor, HSG C, Udorthents (2E)
22.149	69	TOTAL AREA

Pre-Dev

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
8.750	HSG A	1E
0.580	HSG B	1E, 2E
12.819	HSG C	1E, 2E
0.000	HSG D	
0.000	Other	
22.149		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
6.450	0.000	1.622	0.000	0.000	8.072	Dirt roads	1E, 2E
1.840	0.180	8.004	0.000	0.000	10.024	Woods, Good	1E, 2E
0.460	0.400	3.193	0.000	0.000	4.053	Woods, Poor	1E, 2E
8.750	0.580	12.819	0.000	0.000	22.149	TOTAL AREA	

Pre-Dev

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Type III 24-hr 2-Year Rainfall=3.10"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: Westerly Portion of Site

Runoff Area=13.898 ac 0.00% Impervious Runoff Depth>0.49"
Flow Length=846' Tc=10.8 min CN=65 Runoff=5.65 cfs 0.566 af

Subcatchment 2E: Easterly Portion of Site

Runoff Area=8.251 ac 0.00% Impervious Runoff Depth>0.98"
Flow Length=912' Tc=19.8 min CN=76 Runoff=6.75 cfs 0.677 af

Reach POA-1: Wetlands

Inflow=5.65 cfs 0.566 af
Outflow=5.65 cfs 0.566 af

Reach POA-2: Wetlands

Inflow=6.75 cfs 0.677 af
Outflow=6.75 cfs 0.677 af

Total Runoff Area = 22.149 ac Runoff Volume = 1.243 af Average Runoff Depth = 0.67"
100.00% Pervious = 22.149 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1E: Westerly Portion of Site

Runoff = 5.65 cfs @ 12.19 hrs, Volume= 0.566 af, Depth> 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (ac)	CN	Description
1.840	30	Woods, Good, HSG A
1.440	70	Woods, Good, HSG C
2.720	70	Woods, Good, HSG C
* 0.583	70	Woods, Good, HSG C, Udorthents
* 0.180	55	Woods, Good, HSG B/D [Choose B]
6.450	72	Dirt roads, HSG A
* 0.042	87	Dirt roads, HSG C, Udorthents
0.460	45	Woods, Poor, HSG A
0.183	77	Woods, Poor, HSG C
13.898	65	Weighted Average
13.898		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	10	0.0600	0.04		Sheet Flow, Sheet
					Woods: Dense underbrush n= 0.800 P2= 3.10"
4.3	460	0.1290	1.80		Shallow Concentrated Flow, Shallow
					Woodland Kv= 5.0 fps
1.8	255	0.0550	2.35		Shallow Concentrated Flow, Shallow
					Nearly Bare & Untilled Kv= 10.0 fps
0.8	121	0.1320	2.54		Shallow Concentrated Flow, Shallow
					Short Grass Pasture Kv= 7.0 fps
10.8	846	Total			

Summary for Subcatchment 2E: Easterly Portion of Site

Runoff = 6.75 cfs @ 12.30 hrs, Volume= 0.677 af, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

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Type III 24-hr 2-Year Rainfall=3.10"

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Area (ac)	CN	Description
1.020	70	Woods, Good, HSG C
0.660	70	Woods, Good, HSG C
* 0.070	70	Woods, Good, HSG C, Udorthents
* 0.071	70	Woods, Good, HSG C, Udorthents
0.760	87	Dirt roads, HSG C
* 0.820	87	Dirt roads, HSG C, Udorthents
2.440	77	Woods, Poor, HSG C
1.440	70	Woods, Good, HSG C
* 0.570	77	Woods, Poor, HSG C, Udorthents
* 0.400	66	Woods, Poor, HSG B/D [Choose B]
8.251	76	Weighted Average
8.251		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	10	0.0050	0.02		Sheet Flow, Sheet Woods: Dense underbrush n= 0.800 P2= 3.10"
5.3	617	0.1520	1.95		Shallow Concentrated Flow, Shallow Woodland Kv= 5.0 fps
4.0	285	0.0140	1.18		Shallow Concentrated Flow, Shallow Nearly Bare & Untilled Kv= 10.0 fps
19.8	912	Total			

Summary for Reach POA-1: Wetlands

Inflow Area = 13.898 ac, 0.00% Impervious, Inflow Depth > 0.49" for 2-Year event
 Inflow = 5.65 cfs @ 12.19 hrs, Volume= 0.566 af
 Outflow = 5.65 cfs @ 12.19 hrs, Volume= 0.566 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach POA-2: Wetlands

Inflow Area = 8.251 ac, 0.00% Impervious, Inflow Depth > 0.98" for 2-Year event
 Inflow = 6.75 cfs @ 12.30 hrs, Volume= 0.677 af
 Outflow = 6.75 cfs @ 12.30 hrs, Volume= 0.677 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Pre-Dev*Type III 24-hr 10-Year Rainfall=4.50"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: Westerly Portion of Site Runoff Area=13.898 ac 0.00% Impervious Runoff Depth>1.21"
Flow Length=846' Tc=10.8 min CN=65 Runoff=16.92 cfs 1.396 af

Subcatchment 2E: Easterly Portion of Site Runoff Area=8.251 ac 0.00% Impervious Runoff Depth>1.96"
Flow Length=912' Tc=19.8 min CN=76 Runoff=13.78 cfs 1.350 af

Reach POA-1: Wetlands Inflow=16.92 cfs 1.396 af
Outflow=16.92 cfs 1.396 af

Reach POA-2: Wetlands Inflow=13.78 cfs 1.350 af
Outflow=13.78 cfs 1.350 af

Total Runoff Area = 22.149 ac Runoff Volume = 2.746 af Average Runoff Depth = 1.49"
100.00% Pervious = 22.149 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1E: Westerly Portion of Site

Runoff = 16.92 cfs @ 12.17 hrs, Volume= 1.396 af, Depth> 1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (ac)	CN	Description
1.840	30	Woods, Good, HSG A
1.440	70	Woods, Good, HSG C
2.720	70	Woods, Good, HSG C
* 0.583	70	Woods, Good, HSG C, Udorthents
* 0.180	55	Woods, Good, HSG B/D [Choose B]
6.450	72	Dirt roads, HSG A
* 0.042	87	Dirt roads, HSG C, Udorthents
0.460	45	Woods, Poor, HSG A
0.183	77	Woods, Poor, HSG C
13.898	65	Weighted Average
13.898		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	10	0.0600	0.04		Sheet Flow, Sheet
					Woods: Dense underbrush n= 0.800 P2= 3.10"
4.3	460	0.1290	1.80		Shallow Concentrated Flow, Shallow
					Woodland Kv= 5.0 fps
1.8	255	0.0550	2.35		Shallow Concentrated Flow, Shallow
					Nearly Bare & Untilled Kv= 10.0 fps
0.8	121	0.1320	2.54		Shallow Concentrated Flow, Shallow
					Short Grass Pasture Kv= 7.0 fps
10.8	846	Total			

Summary for Subcatchment 2E: Easterly Portion of Site

Runoff = 13.78 cfs @ 12.28 hrs, Volume= 1.350 af, Depth> 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

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Type III 24-hr 10-Year Rainfall=4.50"

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Area (ac)	CN	Description
1.020	70	Woods, Good, HSG C
0.660	70	Woods, Good, HSG C
* 0.070	70	Woods, Good, HSG C, Udorthents
* 0.071	70	Woods, Good, HSG C, Udorthents
0.760	87	Dirt roads, HSG C
* 0.820	87	Dirt roads, HSG C, Udorthents
2.440	77	Woods, Poor, HSG C
1.440	70	Woods, Good, HSG C
* 0.570	77	Woods, Poor, HSG C, Udorthents
* 0.400	66	Woods, Poor, HSG B/D [Choose B]
8.251	76	Weighted Average
8.251		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	10	0.0050	0.02		Sheet Flow, Sheet Woods: Dense underbrush n= 0.800 P2= 3.10"
5.3	617	0.1520	1.95		Shallow Concentrated Flow, Shallow Woodland Kv= 5.0 fps
4.0	285	0.0140	1.18		Shallow Concentrated Flow, Shallow Nearly Bare & Untilled Kv= 10.0 fps
19.8	912	Total			

Summary for Reach POA-1: Wetlands

Inflow Area = 13.898 ac, 0.00% Impervious, Inflow Depth > 1.21" for 10-Year event
 Inflow = 16.92 cfs @ 12.17 hrs, Volume= 1.396 af
 Outflow = 16.92 cfs @ 12.17 hrs, Volume= 1.396 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach POA-2: Wetlands

Inflow Area = 8.251 ac, 0.00% Impervious, Inflow Depth > 1.96" for 10-Year event
 Inflow = 13.78 cfs @ 12.28 hrs, Volume= 1.350 af
 Outflow = 13.78 cfs @ 12.28 hrs, Volume= 1.350 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Pre-Dev*Type III 24-hr 100-Year Rainfall=6.50"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: Westerly Portion of Site Runoff Area=13.898 ac 0.00% Impervious Runoff Depth>2.50"
Flow Length=846' Tc=10.8 min CN=65 Runoff=36.85 cfs 2.900 af

Subcatchment 2E: Easterly Portion of Site Runoff Area=8.251 ac 0.00% Impervious Runoff Depth>3.55"
Flow Length=912' Tc=19.8 min CN=76 Runoff=24.94 cfs 2.441 af

Reach POA-1: Wetlands Inflow=36.85 cfs 2.900 af
Outflow=36.85 cfs 2.900 af

Reach POA-2: Wetlands Inflow=24.94 cfs 2.441 af
Outflow=24.94 cfs 2.441 af

Total Runoff Area = 22.149 ac Runoff Volume = 5.341 af Average Runoff Depth = 2.89"
100.00% Pervious = 22.149 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1E: Westerly Portion of Site

Runoff = 36.85 cfs @ 12.16 hrs, Volume= 2.900 af, Depth> 2.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (ac)	CN	Description
1.840	30	Woods, Good, HSG A
1.440	70	Woods, Good, HSG C
2.720	70	Woods, Good, HSG C
* 0.583	70	Woods, Good, HSG C, Udorthents
* 0.180	55	Woods, Good, HSG B/D [Choose B]
6.450	72	Dirt roads, HSG A
* 0.042	87	Dirt roads, HSG C, Udorthents
0.460	45	Woods, Poor, HSG A
0.183	77	Woods, Poor, HSG C
13.898	65	Weighted Average
13.898		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	10	0.0600	0.04		Sheet Flow, Sheet
					Woods: Dense underbrush n= 0.800 P2= 3.10"
4.3	460	0.1290	1.80		Shallow Concentrated Flow, Shallow
					Woodland Kv= 5.0 fps
1.8	255	0.0550	2.35		Shallow Concentrated Flow, Shallow
					Nearly Bare & Untilled Kv= 10.0 fps
0.8	121	0.1320	2.54		Shallow Concentrated Flow, Shallow
					Short Grass Pasture Kv= 7.0 fps
10.8	846	Total			

Summary for Subcatchment 2E: Easterly Portion of Site

Runoff = 24.94 cfs @ 12.27 hrs, Volume= 2.441 af, Depth> 3.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Pre-Dev

Type III 24-hr 100-Year Rainfall=6.50"

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Area (ac)	CN	Description
1.020	70	Woods, Good, HSG C
0.660	70	Woods, Good, HSG C
* 0.070	70	Woods, Good, HSG C, Udorthents
* 0.071	70	Woods, Good, HSG C, Udorthents
0.760	87	Dirt roads, HSG C
* 0.820	87	Dirt roads, HSG C, Udorthents
2.440	77	Woods, Poor, HSG C
1.440	70	Woods, Good, HSG C
* 0.570	77	Woods, Poor, HSG C, Udorthents
* 0.400	66	Woods, Poor, HSG B/D [Choose B]
8.251	76	Weighted Average
8.251		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	10	0.0050	0.02		Sheet Flow, Sheet Woods: Dense underbrush n= 0.800 P2= 3.10"
5.3	617	0.1520	1.95		Shallow Concentrated Flow, Shallow Woodland Kv= 5.0 fps
4.0	285	0.0140	1.18		Shallow Concentrated Flow, Shallow Nearly Bare & Untilled Kv= 10.0 fps
19.8	912	Total			

Summary for Reach POA-1: Wetlands

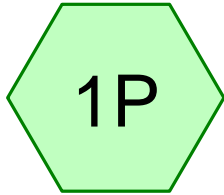
Inflow Area = 13.898 ac, 0.00% Impervious, Inflow Depth > 2.50" for 100-Year event
 Inflow = 36.85 cfs @ 12.16 hrs, Volume= 2.900 af
 Outflow = 36.85 cfs @ 12.16 hrs, Volume= 2.900 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

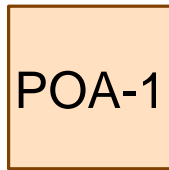
Summary for Reach POA-2: Wetlands

Inflow Area = 8.251 ac, 0.00% Impervious, Inflow Depth > 3.55" for 100-Year event
 Inflow = 24.94 cfs @ 12.27 hrs, Volume= 2.441 af
 Outflow = 24.94 cfs @ 12.27 hrs, Volume= 2.441 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



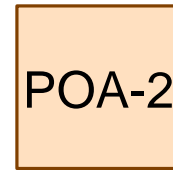
Westerly Portion of Site



Wetlands

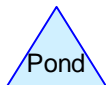
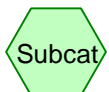


Easterly Portion of Site



Wetlands

Post-Development



Routing Diagram for Post-Dev

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Post-Dev

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.635	30	Brush, Good, HSG A (1P)
1.930	65	Brush, Good, HSG C (1P)
0.810	72	Dirt roads, HSG A, Stockpile Area (1P)
0.350	82	Dirt roads, HSG B/D, Choose B [MIX] (1P)
0.230	76	Gravel roads, HSG A (1P)
0.020	85	Gravel roads, HSG B/D, Choose B (1P)
6.090	30	Meadow, non-grazed, HSG A (1P)
0.150	58	Meadow, non-grazed, HSG B/D, Choose B (1P)
3.930	71	Meadow, non-grazed, HSG C (1P, 2P)
0.230	71	Meadow, non-grazed, HSG C, Udorthents (2P)
0.820	30	Woods, Good, HSG A (1P)
0.400	55	Woods, Good, HSG B/D, Choose B (1P, 2P)
5.070	70	Woods, Good, HSG C (1P, 2P)
1.300	70	Woods, Good, HSG C, Udorthents (2P)
0.016	77	Woods, Poor, HSG C (2P)
0.180	73	Woods/grass comb., Poor, HSG B/D, Choose B (2P)
22.161	56	TOTAL AREA

Post-Dev

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
8.585	HSG A	1P
1.100	HSG B	1P, 2P
12.476	HSG C	1P, 2P
0.000	HSG D	
0.000	Other	
22.161		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.635	0.000	1.930	0.000	0.000	2.565	Brush, Good	1P
0.810	0.350	0.000	0.000	0.000	1.160	Dirt roads	1P
0.230	0.020	0.000	0.000	0.000	0.250	Gravel roads	1P
6.090	0.150	4.160	0.000	0.000	10.400	Meadow, non-grazed	1P, 2P
0.820	0.400	6.370	0.000	0.000	7.590	Woods, Good	1P, 2P
0.000	0.000	0.016	0.000	0.000	0.016	Woods, Poor	2P
0.000	0.180	0.000	0.000	0.000	0.180	Woods/grass comb., Poor	2P
8.585	1.100	12.476	0.000	0.000	22.161	TOTAL AREA	

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Type III 24-hr 2-Year Rainfall=3.10"

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Time span=5.00-36.00 hrs, dt=0.05 hrs, 621 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1P: Westerly Portion of Site

Runoff Area=13.915 ac 0.00% Impervious Runoff Depth=0.07"
Flow Length=743' Tc=12.0 min CN=48 Runoff=0.14 cfs 0.086 af

Subcatchment 2P: Easterly Portion of Site

Runoff Area=8.246 ac 0.00% Impervious Runoff Depth=0.77"
Flow Length=909' Tc=22.7 min CN=70 Runoff=4.18 cfs 0.529 af

Reach POA-1: Wetlands

Inflow=0.14 cfs 0.086 af
Outflow=0.14 cfs 0.086 af

Reach POA-2: Wetlands

Inflow=4.18 cfs 0.529 af
Outflow=4.18 cfs 0.529 af

Total Runoff Area = 22.161 ac Runoff Volume = 0.615 af Average Runoff Depth = 0.33"
100.00% Pervious = 22.161 ac 0.00% Impervious = 0.000 ac

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Type III 24-hr 2-Year Rainfall=3.10"

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Summary for Subcatchment 1P: Westerly Portion of Site

Runoff = 0.14 cfs @ 14.83 hrs, Volume= 0.086 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (ac)	CN	Description
1.470	71	Meadow, non-grazed, HSG C
1.930	65	Brush, Good, HSG C
1.230	70	Woods, Good, HSG C
0.635	30	Brush, Good, HSG A
6.090	30	Meadow, non-grazed, HSG A
* 0.810	72	Dirt roads, HSG A, Stockpile Area
0.230	76	Gravel roads, HSG A
0.820	30	Woods, Good, HSG A
* 0.150	58	Meadow, non-grazed, HSG B/D, Choose B
* 0.020	85	Gravel roads, HSG B/D, Choose B
* 0.180	55	Woods, Good, HSG B/D, Choose B
* 0.350	82	Dirt roads, HSG B/D, Choose B [MIX]
13.915	48	Weighted Average
13.915		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	10	0.0600	0.04		Sheet Flow, Sheet
					Woods: Dense underbrush n= 0.800 P2= 3.10"
1.6	165	0.1140	1.69		Shallow Concentrated Flow, Shallow
					Woodland Kv= 5.0 fps
3.2	163	0.1140	0.84		Shallow Concentrated Flow, Shallow
					Forest w/Heavy Litter Kv= 2.5 fps
1.1	135	0.0890	2.09		Shallow Concentrated Flow, Shallow
					Short Grass Pasture Kv= 7.0 fps
1.5	149	0.0540	1.63		Shallow Concentrated Flow, SCF
					Short Grass Pasture Kv= 7.0 fps
0.7	121	0.1490	2.70		Shallow Concentrated Flow, SCF
					Short Grass Pasture Kv= 7.0 fps
12.0	743	Total			

Summary for Subcatchment 2P: Easterly Portion of Site

Runoff = 4.18 cfs @ 12.36 hrs, Volume= 0.529 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Post-Dev

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Type III 24-hr 2-Year Rainfall=3.10"

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Area (ac)	CN	Description
1.170	70	Woods, Good, HSG C
0.920	70	Woods, Good, HSG C
0.016	77	Woods, Poor, HSG C
1.750	70	Woods, Good, HSG C
2.460	71	Meadow, non-grazed, HSG C
* 1.300	70	Woods, Good, HSG C, Udorthents
* 0.230	71	Meadow, non-grazed, HSG C, Udorthents
* 0.220	55	Woods, Good, HSG B/D, Choose B
* 0.180	73	Woods/grass comb., Poor, HSG B/D, Choose B
8.246	70	Weighted Average
8.246		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	10	0.0050	0.02		Sheet Flow, Sheet Woods: Dense underbrush n= 0.800 P2= 3.10"
1.7	160	0.1030	1.60		Shallow Concentrated Flow, Shallow Woodland Kv= 5.0 fps
2.7	195	0.2260	1.19		Shallow Concentrated Flow, Shallow Forest w/Heavy Litter Kv= 2.5 fps
1.8	270	0.1300	2.52		Shallow Concentrated Flow, SCF Short Grass Pasture Kv= 7.0 fps
6.0	274	0.0120	0.77		Shallow Concentrated Flow, SCF Short Grass Pasture Kv= 7.0 fps
22.7	909	Total			

Summary for Reach POA-1: Wetlands

Inflow Area = 13.915 ac, 0.00% Impervious, Inflow Depth = 0.07" for 2-Year event
 Inflow = 0.14 cfs @ 14.83 hrs, Volume= 0.086 af
 Outflow = 0.14 cfs @ 14.83 hrs, Volume= 0.086 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Summary for Reach POA-2: Wetlands

Inflow Area = 8.246 ac, 0.00% Impervious, Inflow Depth = 0.77" for 2-Year event
 Inflow = 4.18 cfs @ 12.36 hrs, Volume= 0.529 af
 Outflow = 4.18 cfs @ 12.36 hrs, Volume= 0.529 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Post-Dev*Type III 24-hr 10-Year Rainfall=4.50"*

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Time span=5.00-36.00 hrs, dt=0.05 hrs, 621 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1P: Westerly Portion of Site

Runoff Area=13.915 ac 0.00% Impervious Runoff Depth=0.41"
Flow Length=743' Tc=12.0 min CN=48 Runoff=2.51 cfs 0.479 af

Subcatchment 2P: Easterly Portion of Site

Runoff Area=8.246 ac 0.00% Impervious Runoff Depth=1.67"
Flow Length=909' Tc=22.7 min CN=70 Runoff=9.96 cfs 1.150 af

Reach POA-1: Wetlands

Inflow=2.51 cfs 0.479 af
Outflow=2.51 cfs 0.479 af

Reach POA-2: Wetlands

Inflow=9.96 cfs 1.150 af
Outflow=9.96 cfs 1.150 af

Total Runoff Area = 22.161 ac Runoff Volume = 1.630 af Average Runoff Depth = 0.88"
100.00% Pervious = 22.161 ac 0.00% Impervious = 0.000 ac

Post-Dev

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Type III 24-hr 10-Year Rainfall=4.50"

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Summary for Subcatchment 1P: Westerly Portion of Site

Runoff = 2.51 cfs @ 12.39 hrs, Volume= 0.479 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (ac)	CN	Description
1.470	71	Meadow, non-grazed, HSG C
1.930	65	Brush, Good, HSG C
1.230	70	Woods, Good, HSG C
0.635	30	Brush, Good, HSG A
6.090	30	Meadow, non-grazed, HSG A
* 0.810	72	Dirt roads, HSG A, Stockpile Area
0.230	76	Gravel roads, HSG A
0.820	30	Woods, Good, HSG A
* 0.150	58	Meadow, non-grazed, HSG B/D, Choose B
* 0.020	85	Gravel roads, HSG B/D, Choose B
* 0.180	55	Woods, Good, HSG B/D, Choose B
* 0.350	82	Dirt roads, HSG B/D, Choose B [MIX]
13.915	48	Weighted Average
13.915		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	10	0.0600	0.04		Sheet Flow, Sheet
					Woods: Dense underbrush n= 0.800 P2= 3.10"
1.6	165	0.1140	1.69		Shallow Concentrated Flow, Shallow
					Woodland Kv= 5.0 fps
3.2	163	0.1140	0.84		Shallow Concentrated Flow, Shallow
					Forest w/Heavy Litter Kv= 2.5 fps
1.1	135	0.0890	2.09		Shallow Concentrated Flow, Shallow
					Short Grass Pasture Kv= 7.0 fps
1.5	149	0.0540	1.63		Shallow Concentrated Flow, SCF
					Short Grass Pasture Kv= 7.0 fps
0.7	121	0.1490	2.70		Shallow Concentrated Flow, SCF
					Short Grass Pasture Kv= 7.0 fps
12.0	743	Total			

Summary for Subcatchment 2P: Easterly Portion of Site

Runoff = 9.96 cfs @ 12.34 hrs, Volume= 1.150 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

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Type III 24-hr 10-Year Rainfall=4.50"

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Area (ac)	CN	Description
1.170	70	Woods, Good, HSG C
0.920	70	Woods, Good, HSG C
0.016	77	Woods, Poor, HSG C
1.750	70	Woods, Good, HSG C
2.460	71	Meadow, non-grazed, HSG C
* 1.300	70	Woods, Good, HSG C, Udorthents
* 0.230	71	Meadow, non-grazed, HSG C, Udorthents
* 0.220	55	Woods, Good, HSG B/D, Choose B
* 0.180	73	Woods/grass comb., Poor, HSG B/D, Choose B
8.246	70	Weighted Average
8.246		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	10	0.0050	0.02		Sheet Flow, Sheet Woods: Dense underbrush n= 0.800 P2= 3.10"
1.7	160	0.1030	1.60		Shallow Concentrated Flow, Shallow Woodland Kv= 5.0 fps
2.7	195	0.2260	1.19		Shallow Concentrated Flow, Shallow Forest w/Heavy Litter Kv= 2.5 fps
1.8	270	0.1300	2.52		Shallow Concentrated Flow, SCF Short Grass Pasture Kv= 7.0 fps
6.0	274	0.0120	0.77		Shallow Concentrated Flow, SCF Short Grass Pasture Kv= 7.0 fps
22.7	909	Total			

Summary for Reach POA-1: Wetlands

Inflow Area = 13.915 ac, 0.00% Impervious, Inflow Depth = 0.41" for 10-Year event
 Inflow = 2.51 cfs @ 12.39 hrs, Volume= 0.479 af
 Outflow = 2.51 cfs @ 12.39 hrs, Volume= 0.479 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Summary for Reach POA-2: Wetlands

Inflow Area = 8.246 ac, 0.00% Impervious, Inflow Depth = 1.67" for 10-Year event
 Inflow = 9.96 cfs @ 12.34 hrs, Volume= 1.150 af
 Outflow = 9.96 cfs @ 12.34 hrs, Volume= 1.150 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Post-Dev*Type III 24-hr 100-Year Rainfall=6.50"*

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Time span=5.00-36.00 hrs, dt=0.05 hrs, 621 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1P: Westerly Portion of Site Runoff Area=13.915 ac 0.00% Impervious Runoff Depth=1.24"
Flow Length=743' Tc=12.0 min CN=48 Runoff=12.80 cfs 1.436 af

Subcatchment 2P: Easterly Portion of Site Runoff Area=8.246 ac 0.00% Impervious Runoff Depth=3.21"
Flow Length=909' Tc=22.7 min CN=70 Runoff=19.70 cfs 2.204 af

Reach POA-1: Wetlands Inflow=12.80 cfs 1.436 af
Outflow=12.80 cfs 1.436 af

Reach POA-2: Wetlands Inflow=19.70 cfs 2.204 af
Outflow=19.70 cfs 2.204 af

Total Runoff Area = 22.161 ac Runoff Volume = 3.639 af Average Runoff Depth = 1.97"
100.00% Pervious = 22.161 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1P: Westerly Portion of Site

Runoff = 12.80 cfs @ 12.21 hrs, Volume= 1.436 af, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (ac)	CN	Description
1.470	71	Meadow, non-grazed, HSG C
1.930	65	Brush, Good, HSG C
1.230	70	Woods, Good, HSG C
0.635	30	Brush, Good, HSG A
6.090	30	Meadow, non-grazed, HSG A
* 0.810	72	Dirt roads, HSG A, Stockpile Area
0.230	76	Gravel roads, HSG A
0.820	30	Woods, Good, HSG A
* 0.150	58	Meadow, non-grazed, HSG B/D, Choose B
* 0.020	85	Gravel roads, HSG B/D, Choose B
* 0.180	55	Woods, Good, HSG B/D, Choose B
* 0.350	82	Dirt roads, HSG B/D, Choose B [MIX]
13.915	48	Weighted Average
13.915		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	10	0.0600	0.04		Sheet Flow, Sheet
					Woods: Dense underbrush n= 0.800 P2= 3.10"
1.6	165	0.1140	1.69		Shallow Concentrated Flow, Shallow
					Woodland Kv= 5.0 fps
3.2	163	0.1140	0.84		Shallow Concentrated Flow, Shallow
					Forest w/Heavy Litter Kv= 2.5 fps
1.1	135	0.0890	2.09		Shallow Concentrated Flow, Shallow
					Short Grass Pasture Kv= 7.0 fps
1.5	149	0.0540	1.63		Shallow Concentrated Flow, SCF
					Short Grass Pasture Kv= 7.0 fps
0.7	121	0.1490	2.70		Shallow Concentrated Flow, SCF
					Short Grass Pasture Kv= 7.0 fps
12.0	743	Total			

Summary for Subcatchment 2P: Easterly Portion of Site

Runoff = 19.70 cfs @ 12.32 hrs, Volume= 2.204 af, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

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Type III 24-hr 100-Year Rainfall=6.50"

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Area (ac)	CN	Description
1.170	70	Woods, Good, HSG C
0.920	70	Woods, Good, HSG C
0.016	77	Woods, Poor, HSG C
1.750	70	Woods, Good, HSG C
2.460	71	Meadow, non-grazed, HSG C
* 1.300	70	Woods, Good, HSG C, Udorthents
* 0.230	71	Meadow, non-grazed, HSG C, Udorthents
* 0.220	55	Woods, Good, HSG B/D, Choose B
* 0.180	73	Woods/grass comb., Poor, HSG B/D, Choose B
8.246	70	Weighted Average
8.246		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	10	0.0050	0.02		Sheet Flow, Sheet Woods: Dense underbrush n= 0.800 P2= 3.10"
1.7	160	0.1030	1.60		Shallow Concentrated Flow, Shallow Woodland Kv= 5.0 fps
2.7	195	0.2260	1.19		Shallow Concentrated Flow, Shallow Forest w/Heavy Litter Kv= 2.5 fps
1.8	270	0.1300	2.52		Shallow Concentrated Flow, SCF Short Grass Pasture Kv= 7.0 fps
6.0	274	0.0120	0.77		Shallow Concentrated Flow, SCF Short Grass Pasture Kv= 7.0 fps
22.7	909	Total			

Summary for Reach POA-1: Wetlands

Inflow Area = 13.915 ac, 0.00% Impervious, Inflow Depth = 1.24" for 100-Year event
 Inflow = 12.80 cfs @ 12.21 hrs, Volume= 1.436 af
 Outflow = 12.80 cfs @ 12.21 hrs, Volume= 1.436 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Summary for Reach POA-2: Wetlands

Inflow Area = 8.246 ac, 0.00% Impervious, Inflow Depth = 3.21" for 100-Year event
 Inflow = 19.70 cfs @ 12.32 hrs, Volume= 2.204 af
 Outflow = 19.70 cfs @ 12.32 hrs, Volume= 2.204 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Appendix B
Operation and Maintenance Plan
Long Term Pollution Prevention Plan

Annual Site Inspection Protocol

Operation & Maintenance Department

SERVICES

During the Term, Contractor shall perform the following services on each System:

Each System will be installed with an Internet-based Data Acquisition System (DAS). The DAS will have the capability to send alarms identifying communication and power generation issues.

Description of Work	Frequency
On-Call System Service Technician	Per request
Full System Electrical Inspection & Maintenance	One time per year
Module Washing	Optional (maximum once per year)
Vegetation Management	Minimum of once per year

Scope of Work

1. On-call Service Technician:

In response to an automated DAS alarm or request by Customer, a Service Technician will be required to visit the site within three (3) business days of notification to trouble shoot and resolve the issue. Emergency situations may require faster response.

2. System Electrical Inspection & Maintenance:

a. Electrical Maintenance

The technician will:

- Perform a visual inspection of PV modules and array wiring, strain relief, mounting system, trackers, inverters, switchgear, transformers, combiner boxes, wireways and conduit, data acquisition system, weather sensors and outdoor lighting.
- Check pyranometers and reference cells.
- Record operational data from inverters and meters.
- IR Thermography may be used as part of the visual inspection process.

b. Inspect External and/or Internal DC Disconnects and Combiner Boxes

During the inspection, the technician will:

- Ensure that Imp testing is performed on all DC strings, and values are logged on the Borrego provided form.
- Spot check torque values and tighten loose electrical connections.

c. Inverter and Transformer

The technician will:

- Clean out all electrical enclosures
- Clean inverter air filters
- Perform Preventive Maintenance per manufacturer protocol as required to maintain inverter manufacturer's warranty.

- d. AC Disconnects
 - i. The technician will check for proper operation.
- e. DAS
 - i. Verify with Borrego O&M representative before leaving site that the DAS system is functioning properly.
- f. Fencing, Gates, Civil
 - i. Annual visit will include a visual inspection of any fences, gates, equipment pads, etc. Facility improvements installed by Borrego Solar such as gravel access roads, etc. shall be inspected on a periodic basis per Borrego Solar.
- g. Service Report
 - i. A report must be filed with Borrego noting results of the annual inspection.

3. Module Washing

At a maximum, modules might be washed once per year. Water trucks will provide wash water. No chemical additives or cleaners will be used. Additional washings may be requested by Borrego based upon system performance objectives and site-specific environmental conditions.

4. Vegetation Management

Ground cover shall be mowed a minimum of once per year. Additional mowing may be necessary and will be noted in the annual report.

The site shall be inspected for evidence of erosion and rilling in any slopes. Any such conditions shall be noted in the annual report for re-vegetating.

Growth of trees or other vegetation that is having a shade impact on the arrays should be noted in the annual report. Vegetation growth (saplings, bush, large weeds, etc.) within any array fences or inverter enclosures shall be removed.

Additional vegetation management (exterior to the array fences) in accordance with the Yearly Management Plan included in the Order of Conditions shall be strictly adhered to.

Borrego Solar System, Inc.

Matt Murphy, Director of Operations & Maintenance

Signature

Date

Long Term Pollution Prevention Plan

Good Housekeeping Practices

The Owner/Operator shall employ the use of good housekeeping practices by adhering to the maintenance schedules and procedures described in Appendix B - Operations and Maintenance Plan of this report.

Provisions for storing materials/waste products

The storing of hazardous materials and waste is not anticipated with this project. Materials Safety Data Sheets (MSDS) are not required since no materials or substances will be permanently stored on site.

Vehicle Washing

The washing of vehicles is not anticipated with this project.

Solar Panel Washing

The washing of panels is not typically required in the Northeast, as the average monthly rainfall amounts are sufficient to clean the panels. If it is determined that local conditions warrant cleaning of the panels, a construction water truck and non-toxic, bio-degradable materials will be used.

Requirements for routine inspections and maintenance of stormwater BMP's

The Operator shall adhere to the maintenance schedules and procedures described in Appendix B - Operations and Maintenance Plan of this report.

Spill Prevention and Response Plans

There is a minimal risk of a large spill requiring action on this project. Hazardous materials (such as, pesticides, petroleum products, fertilizers, detergents, acids, paints, cleaning solvents, etc.) will not be stored on-site.

In the event of a spill of hazardous substances or oil, the following procedures must be followed:

- All measures must be taken to contain and abate the spill and to prevent the discharge of hazardous substances or oil to storm water or off-site
- For spills less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless and imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.
- For spills greater than five (5) gallons of material, immediately contact the MA DEP Hazardous Waste Incident Response Group at (617) 792-7653 and an approved emergency response contractor. Provide information to emergency response contractor (or coordinator) on the type of material that spilled, the location, the estimated quantity and the time of the spill.

If there is a Reportable Quantity (RQ) release, notify the National Response Center immediately at (800) 424-8802. Within 14 days a report must be submitted to the EPA Regional Office describing the release, the date and circumstances of the release and the steps taken to prevent another release. This Long Term Pollution Prevention Plan must be updated to reflect any changes or steps taken to prevent the same for reoccurring.

Provisions for maintenance of landscaped areas.

Ground cover shall be mowed a minimum of once per year. Additional mowing may be necessary.

Provisions for solid waste management

A solid waste management program during construction (including dumpster, trash receptacles) shall be implemented, inspected and maintained in accordance with local and state requirements. During construction a properly sized dumpster will be on-site. No permanent dumpsters are proposed.

Emergency Contacts

Borrego Solar

Joe Busch, Director of Operations
1115 Westford Street, 2nd Floor
Lowell, MA 01851
Mobile: 978-602-0630
Office: 978-513-2637
jbusch@borregosolar.com

Matt Murphy, Director of O & M
1115 Westford Street, 2nd Floor
Lowell, MA 01851
Mobile: 617-820-8885
Office: 978-513-2608
mmurphy@borregosolar.com

Town of Stow

Fire Department

Fire Chief, Joseph Landry
16 Crescent Street
Stow, MA 01775
Emergency: Dial 911
978-897-4537

Police Department

Police Chief, William Bosworth
305 Great Road
Stow, MA 01775
Emergency: Dial 911
978-897-4545

Town of Acton

Fire Department

Fire Chief, Patric Futterer
371 Main Street
Acton, MA 01720
Emergency: Dial 911
978-264-9645

Police Department

Police Chief, Francis J. Widmayer, III
371 Main Street
Acton, MA 01720
Emergency: Dial 911
978-264-9638

Massachusetts Department of Environmental Protection

(617) 292-5500

United States Environmental Protection Agency

(617) 918-1111

Appendix C
Illicit Discharge Statement

Illicit Discharge Statement:

The stormwater management system outlined in these plans is the system for conveying, treating, and infiltrating stormwater on site including stormwater best management practices intended to transport stormwater to the ground water. The control measures that have been included in the attached plans will be strictly followed to ensure that only storm water related discharges occur. By definition, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, de-chlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents. Illicit discharges, if they exist currently, will be contained and eliminated in accordance with local, state and federal regulations and will be prohibited in the proposed project.



David M. Albrecht, PE
For Borrego Solar

Date: February 29, 2016

Appendix D

Supporting Documentation

Table 2-2b Runoff curve numbers for cultivated agricultural lands¹

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment ²	Hydrologic condition ³	A	B	C	D
Barrow	Barrow soil		77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	86	89
		Good	67	76	81	84
	SR + CR	Poor	71	80	85	88
		Good	66	75	80	83
	Contoured (C)	Poor	70	79	84	87
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
Small grain	C&T + CR	Poor	65	73	79	81
		Good	61	70	77	80
	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	59	72	80	83
Close-seeded or broadcast legumes or pasture	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	86
		Good	60	73	81	84
	C&T	Poor	63	73	80	83
		Good	59	72	79	82
	C&T + CR	Poor	62	72	79	82

¹ Average runoff condition, and $I_a=0.2S$ ² Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.³ Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of surface cover, (c) amount of erosion on close-seeded legumes, (d) percent of residue cover on the land surface (except > 90%), and (e) degree of soil surface crusting.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands ^{1/}

Cover type	Cover description	Hydrologic condition	Curve numbers for hydrologic soil group			
			A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. ^{2/}		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.		—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. ^{3/}		Poor	48	67	77	83
		Fair	35	56	70	77
		Good	30 ^{4/}	48	65	73
Woods—grass combination (orchard or tree farm). ^{5/}		Poor	57	73	82	86
		Fair	43	65	76	82
		Good	32	58	72	79
Woodchip		—	31	59	72	79
Farmsteads—buildings, lanes, driveways, and surrounding lots.		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80

^{1/} See runoff curve numbers in Table 2-2a.^{2/} ~~Poor: <50% ground cover or heavily grazed with no match.~~~~Fair: 50 to 75% ground cover and well grazed.~~~~Good: >75% ground cover and little or only occasional grazing.~~^{3/} ~~Poor: <50% ground cover.~~~~Fair: 50 to 75% ground cover.~~~~Good: >75% ground cover.~~^{4/} Actual curve number is less than 30; use CN = 30 for runoff computations.^{5/} CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.^{6/} ~~Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.~~~~Fair: Woods are grazed but not burned, and some forest litter covers the soil.~~~~Good: Woods are protected from grazing, and litter and brush adequately cover the soil.~~

Table 2-2d Runoff curve numbers for arid and semiarid rangelands ^{1/}

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition ^{2/}	A ^{3/}	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Chaparral—mountain brush, sagebrush, creosote, mountain mahogany, bitterbrush, mesquite, and other brush.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

^{1/} Average runoff condition, and I_a , = 0.2S. For range in humid regions, use table 2-2c.^{2/} Poor: <30% ground cover (litter, grass, and brush overstory).

Fair: 30 to 70% ground cover.

Good: > 70% ground cover.

^{3/} Curve numbers for group A have been developed only for desert shrub.



Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the [Massachusetts Stormwater Handbook](#). The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.¹ This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8²
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

¹ The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

² For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

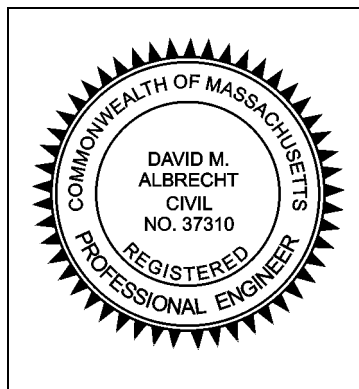
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



2-29-2016

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

- ☒ New development
- ☐ Redevelopment
- ☐ Mix of New Development and Redevelopment



Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
 - ☐ Credit 1
 - ☐ Credit 2
 - ☐ Credit 3
- ☒ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- ☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- ☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- ☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- ☐ Soil Analysis provided.
- ☐ Required Recharge Volume calculation provided.
- ☐ Required Recharge volume reduced through use of the LID site Design Credits.
- ☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - ☐ Static
 - ☐ Simple Dynamic
 - ☐ Dynamic Field¹
- ☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.
- ☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- ☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- ☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
 - ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
 - ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- ☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- ☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

¹ 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- ☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- ☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
 - Provisions for storing materials and waste products inside or under cover;
 - Vehicle washing controls;
 - Requirements for routine inspections and maintenance of stormwater BMPs;
 - Spill prevention and response plans;
 - Provisions for maintenance of lawns, gardens, and other landscaped areas;
 - Requirements for storage and use of fertilizers, herbicides, and pesticides;
 - Pet waste management provisions;
 - Provisions for operation and management of septic systems;
 - Provisions for solid waste management;
 - Snow disposal and plowing plans relative to Wetland Resource Areas;
 - Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- ☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
- ☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
- ☐ is within the Zone II or Interim Wellhead Protection Area
 - ☐ is near or to other critical areas
 - ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - ☐ involves runoff from land uses with higher potential pollutant loads.
- ☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.
- ☐ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- ☐ The BMP is sized (and calculations provided) based on:
 - ☐ The ½" or 1" Water Quality Volume or
 - ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- ☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- ☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- ☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- ☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- ☐ The NPDES Multi-Sector General Permit does **not** cover the land use.
- ☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- ☐ All exposure has been eliminated.
- ☐ All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- ☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- ☐ Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

- ☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
 - ☐ Limited Project
 - ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - ☐ Bike Path and/or Foot Path
 - ☐ Redevelopment Project
 - ☐ Redevelopment portion of mix of new and redevelopment.
- ☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- ☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- ☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- ☐ The project is **not** covered by a NPDES Construction General Permit.
- ☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- ☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- ☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - ☐ Name of the stormwater management system owners;
 - ☒ Party responsible for operation and maintenance;
 - ☒ Schedule for implementation of routine and non-routine maintenance tasks;
 - ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
 - ☐ Description and delineation of public safety features;
 - ☐ Estimated operation and maintenance budget; and
 - ☐ Operation and Maintenance Log Form.
- ☐ The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- ☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- ☒ An Illicit Discharge Compliance Statement is attached;
- ☐ NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.